284-292 Plains Road East
Burlington, ON
Transportation Impact Study Update

Paradigm Transportation Solutions Limited

October 2022

ptsl.com

Project Summary

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284-292 Plains Road East, Burlington, ON Transportation Impact Study Update

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Executive Summary

Content

284 Plains Road Development Inc. retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study (TIS) and Parking Justification for a proposed mid-rise residential development located at 284-292 Plains Road East in the City of Burlington.

This study is an update to the January 2021 TIS, and Parking Justification completed for the site. The study reflects changes to site concept plan and comments received from the City of Burlington. The study determines the impacts of the development traffic on the surrounding road network and identifies the recommended improvements to accommodate the site generated traffic.

Development Concept

The subject site is located at 284-292 Plains Road East in the City of Burlington. The site is adjacent to the City of Burlington's Aldershot Major Transit Station Area (MTSA). The city defines this area as an intensification area and is intended to foster a more pedestrian and transit friendly urban environment through a mix of dense residential, employment, and retail land uses.

The proposed 7-storey mid-rise building contains 107 units and 116 parking spaces (1.08 spaces per unit). Occupant parking is identified on the site plan as 107 spaces (1.00 spaces per unit) and visitor parking is identified on the site plan as 9 spaces (0.08 spaces per unit).

The proposed site plan consolidates the three existing private driveways to Plains Road East into one driveway. The proposed driveway is located approximately 75 m west of Filmandale Road.

The site is expected to be built-out and occupied by Year 2025.

Conclusions

The main findings and conclusions of this study are as follows:

- **Study Area**: The intersections that form the study area include:
  - Plains Road East and Shadeland Avenue/Gallagher Road (signalized);
  - Plains Road East and Filmandale Road (unsignalized);

  - Plains Road East and Downsview Drive (signalized); and
  - Plains Road East and the proposed site driveway.
- **Existing Traffic Conditions**: The intersections within the study area are generally operating with acceptable levels of service during the AM and PM peak hours. The following critical movements are noted:
  - Plains Road East at Shadeland Avenue/Gallagher Road: The northbound and southbound queue lengths are estimated to exceed the current available storage length; and
  - Plains Road East at Filmandale Road/Private Driveway: Localized congestion is occurring on the southbound approach (private driveway).
- **Forecast Traffic**: The forecast traffic volumes near the subject site have been assessed for a five-year horizon (Year 2030) from the anticipated build-out date (Year 2025).
- **Background Traffic Conditions**: The noted queue lengths and localized congestion identified under existing conditions is anticipated to continue to occur.
- **Site Generated Traffic**: The subject site is forecast to generate approximately 35 vehicle trips during the AM peak hour and approximately 42 vehicle trips during the PM peak hour.
- **Transportation Demand Management**: The site concept plan includes TDM measures intended to assist in mitigating the site's transportation and parking impacts. Measures are aimed at walk, transit, cycling, parking, and education/promotion.
- **Parking Demand**: The site's parking demand is forecast to be less than the proposed supply.

  Occupant parking is proposed at a rate of 1.00 space per unit and visitor parking is proposed at a rate of 0.08 spaces per unit. These rates were developed and recommended by City staff based on first submission comments. The parking rate is supported by supplemental data collected by City Staff for residential land uses in intensification areas and published data by ITE.
- **Total Traffic Conditions**: The intersections within the study area are forecast to operate with similar levels of service as background traffic conditions. No additional critical movements are noted because of the addition of the site-generated traffic.

Recommendations

Based on the findings of this study, it is recommended that the City of Burlington consider extending the northbound and southbound storage lengths at the Plains Road East and Shadeland Avenue/Gallagher Road intersection to accommodate 20 m and 40 m of storage, respectively.

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1 Introduction

This study is an update to the January 2021 Transportation Impact Study and Parking Justification completed for the site. The study reflects changes in the site concept plan and comments received from the City of Burlington.

1.1 Overview

284 Plains Road Development Inc. retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study (TIS) and Parking Justification for a proposed mid-rise residential development located at 284-292 Plains Road East in the City of Burlington. **Figure 1.1** illustrates the site location.

Pre-study consultation was conducted with City of Burlington staff via email in August 2020. **Appendix A** contains the pre-study consultation material and the December 2021 transportation planning comments received from the first submission. The study follows the Halton Region TIS Guidelines[1].

The scope of the study includes:

- Assessing current traffic and site conditions within the study area for the weekday AM and PM peak hours;
- Forecasting future non-development (background) traffic growth;
- Forecasting site-generated traffic;
- Analysing future traffic impacts on the surrounding road network;
- Recommending any necessary mitigation; and
- Forecasting the site's parking demand.

[1] Halton Region, *Transportation Impact Study Guidelines,* (Oakville: Halton Region, 2015).

1.2 Study Area

The study area intersections assessed in this study include:

- Plains Road East and Shadeland Avenue/Gallagher Road (signalized);
- Plains Road East and Filmandale Road/Private Driveway (unsignalized);
- Plains Road East and Downsview Drive (signalized); and
- Plains Road East and the proposed site driveway.



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Location of Subject Site

2 Existing Conditions

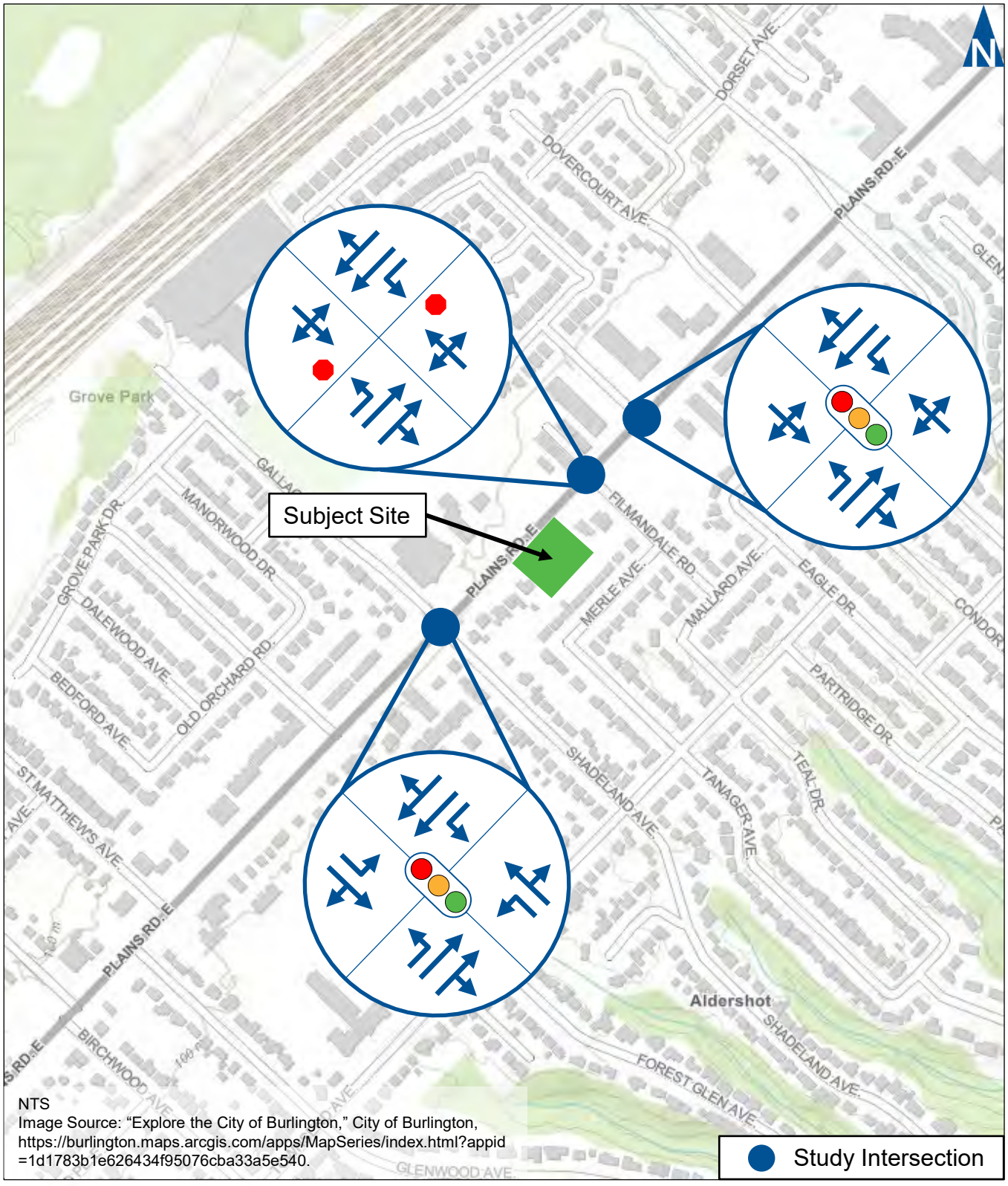
2.1 Road Network

The roadways of interest within the study area include:

- **Plains Road East**, an east-west five-lane multi-purpose arterial[2] roadway with a centre two-way left-turn lane. The roadway has a posted speed limit of 60 km/h and during school bell times, a flashing speed limit of 40 km/h is in effect. Sidewalks are present on both sides of this roadway within the study area. The intersections with Shadeland Avenue/Gallagher Road and Downsview Drive are signalized and operate with auxiliary turn lanes. No on-street parking is permitted within the study area.
- **Shadeland Avenue/Gallagher Road**, a north-south two-lane, 40 km/h local roadway. Sidewalks are present along the east side of this roadway. No on-street parking restrictions are noted in the study area.
- **Filmandale Road**, a north-south two-lane local roadway with an unposted assumed speed limit of 40 km/h. A private driveway forms the north leg of the Filmandale Road and Plains Road East intersection. No sidewalks are present within the study area. No on-street parking restrictions are noted in the study area.
- **Downsview Drive**, a north-south two-lane, 40 km/h local roadway. A private driveway forms the south leg of the Downsview Drive and Plains Road East intersection. Sidewalks are present on both sides of the roadway. No on-street parking restrictions are noted in the study area.

Figure 2.1 illustrates the existing lane configuration and traffic control at the study area intersections.

[2] City of Burlington, *Burlington's Official Plan: Schedule O-1 Classification of Transportation Facilities – Urban Area,* (Burlington: City of Burlington, 2020).



Existing Traffic Control and Lane Configuration

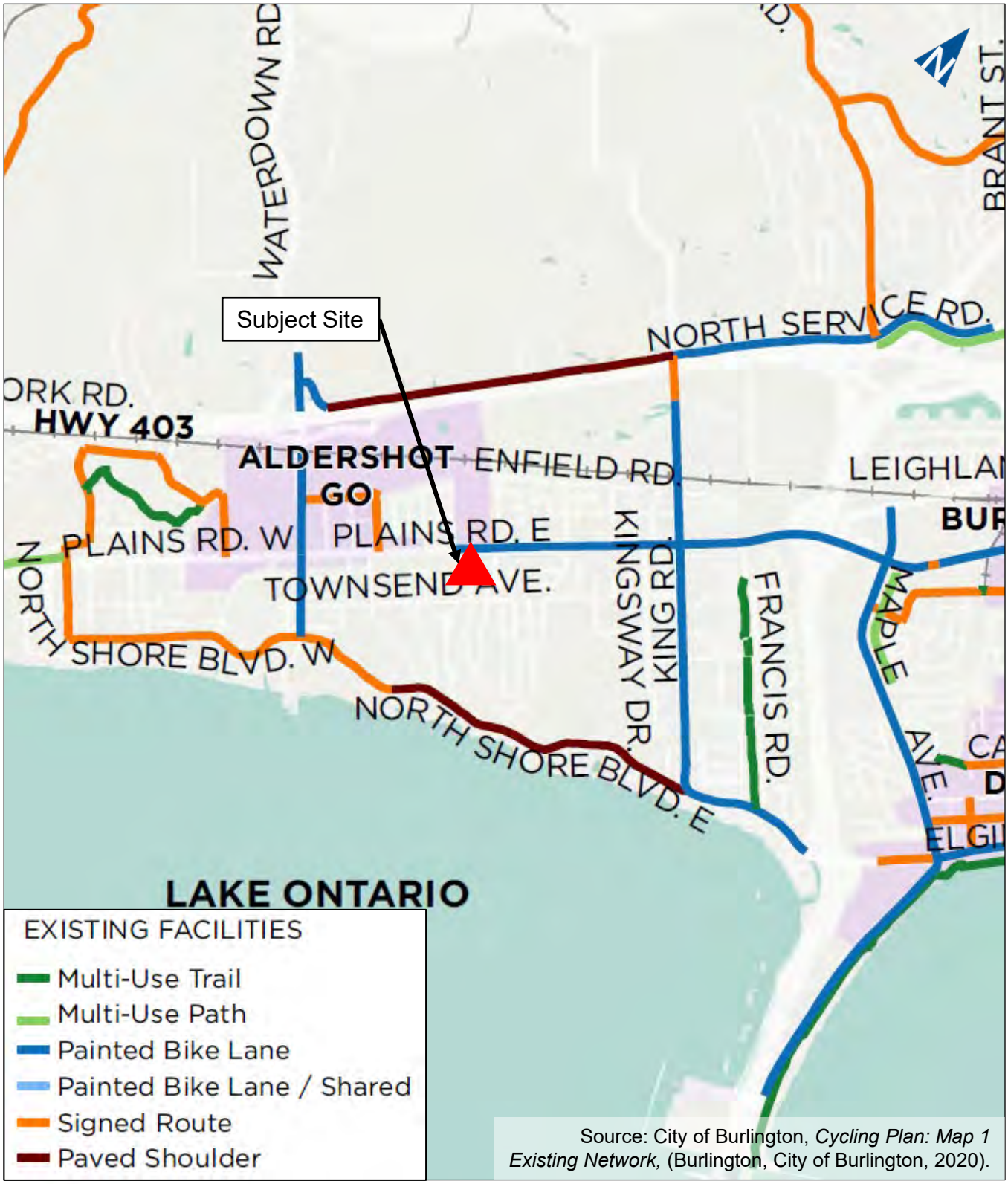
2.2 Cycling Network

The City of Burlington's bicycle network provides a variety of cycling facilities within the immediate area. **Figure 2.2** illustrates the existing cycling network.

On-street bicycle lanes are provided in both directions along Plains Road East, east of Shadeland Avenue/Gallagher Road.

The City of Burlington's draft Cycling Plan[3] identifies a Protected Bikeway along Plains Road East and a Shared Use Lane on Filmandale Road.

[3] City of Burlington, *Cycling Plan: Map 5 Proposed Network,* (Burlington, City of Burlington, 2019). *Map 7 Proposed Project Priority* (Burlington, City of Burlington, 2020).



Source: City of Burlington, *Cycling Plan: Map 1 Existing Network,* (Burlington, City of Burlington, 2020).

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Existing Cycling Network

2.3 Transit Service

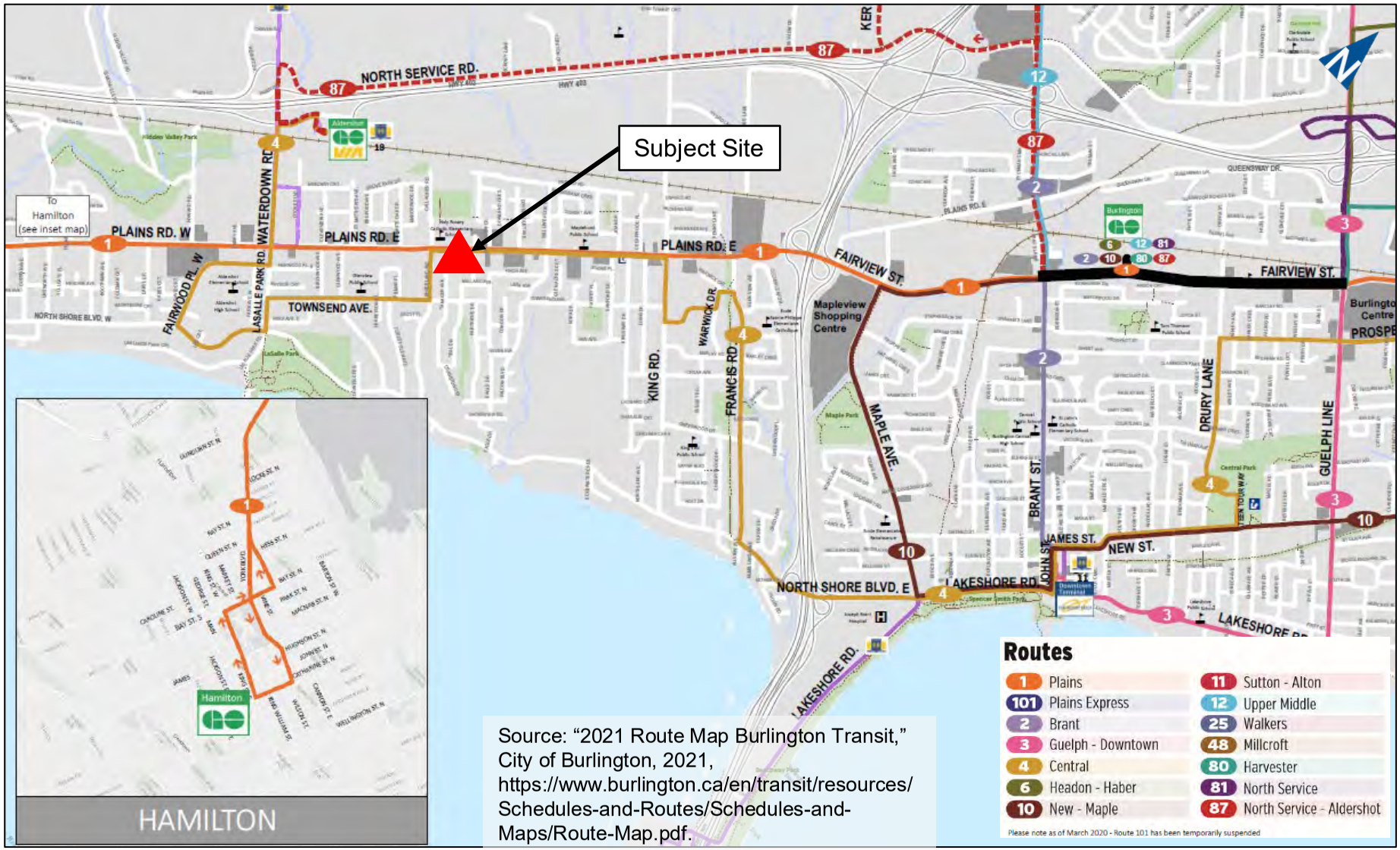
Burlington Transit operates two routes adjacent to the subject site. **Table 2.1** summarizes the existing routes, service headways and schedule. **Figure 2.3** illustrates the existing transit network.

The closest eastbound and westbound transit stops are located at the Plains Road East intersection with Downsview Drive, approximately 160 m to the west (2-minute walk). **Figure 2.4** illustrates the nearby transit stops.

TABLE 2.1: EXISTING TRANSIT ROUTES

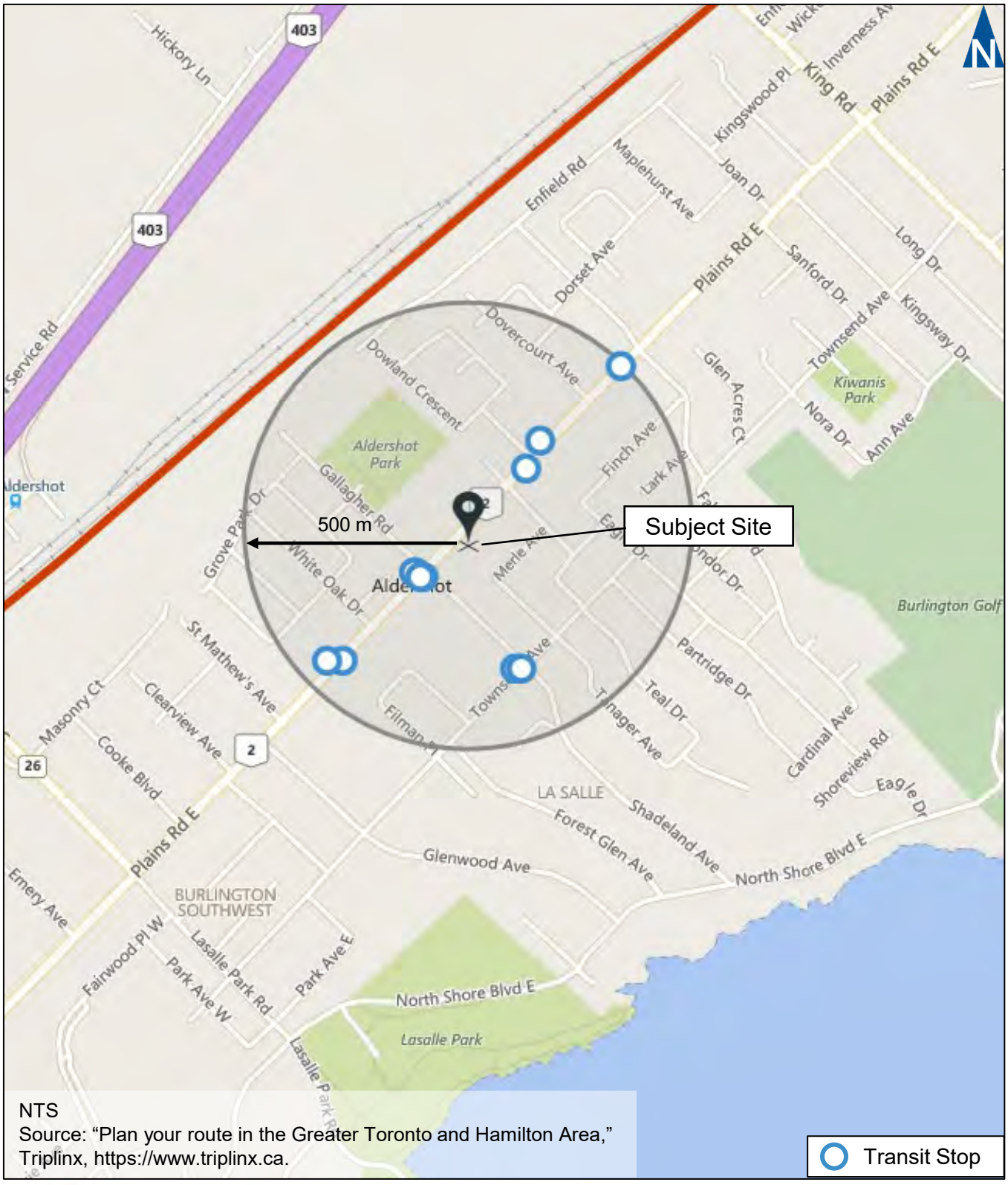
Route	Description*
Burlington Transit Route 1	Offers service 7-days a week between the Appleby GO Station and the City of Hamilton (King & James). Weekday headways range from 10-15 minutes depending on time of day. Weekend headways are in the order of 15-30 minutes.
Burlington Transit Route 4 (Central)	Offers service 7-days a week between the Appleby GO Station and Aldershot GO Station. Weekday headways are in the order of 30 minutes and weekend headways are in the order of 60 minutes.

* Route headways subject to change.



Source: "2021 Route Map Burlington Transit," City of Burlington, 2021, https://www.burlington.ca/en/transit/resources/Schedules-and-Routes/Schedules-and-Maps/Route-Map.pdf.

Existing Transit Network



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Source: "Plan your route in the Greater Toronto and Hamilton Area," Triplinx, https://www.triplinx.ca.

Existing Nearby Transit Stops

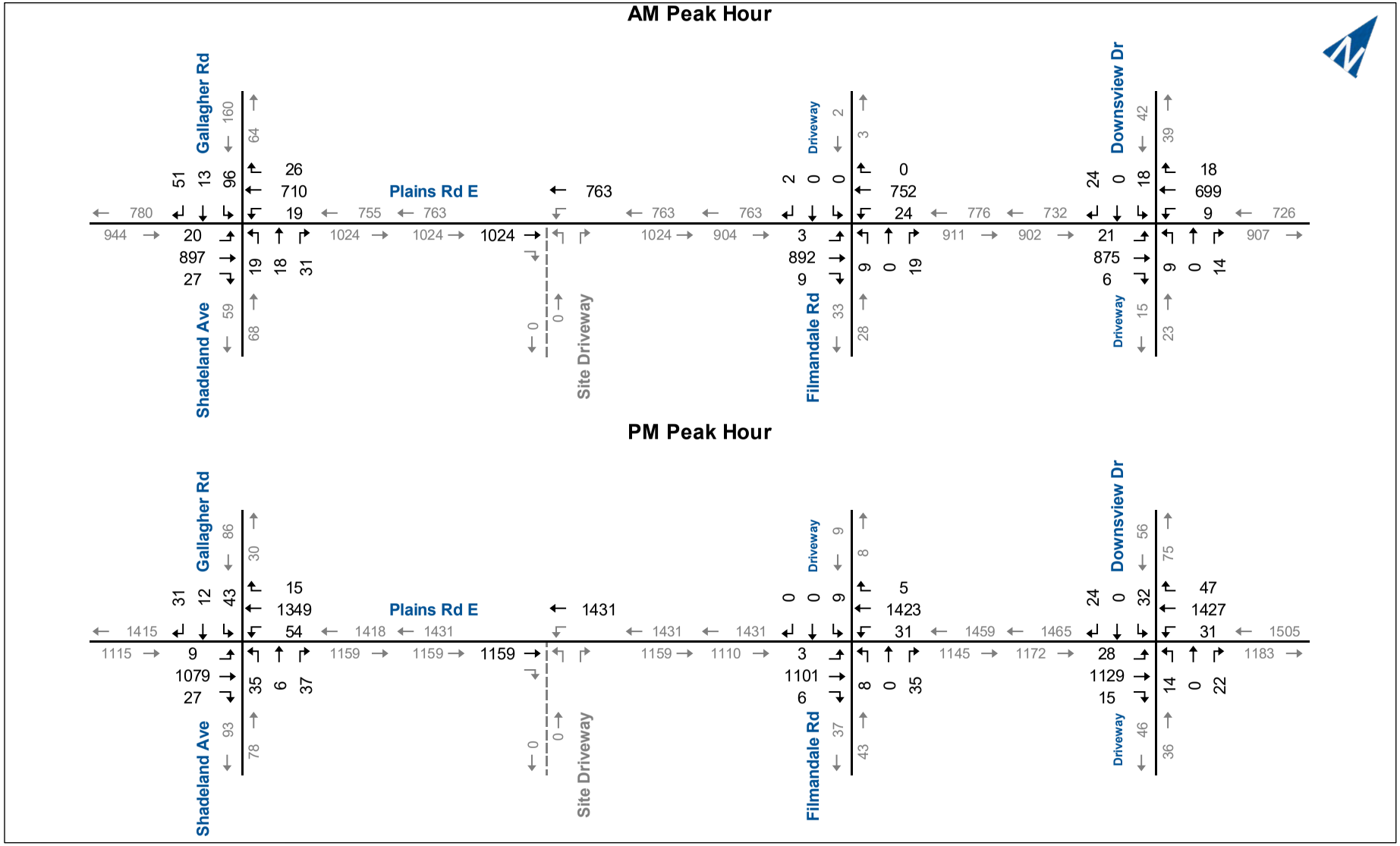
2.4 Traffic Volumes

Turning movement counts were collected at the study area intersections by Pyramid Traffic Incorporated in September 2020.

Due to abnormal traffic patterns caused by the COVID-19 pandemic, the traffic volumes were compared to historical data collected by the City of Burlington (April 2019).

An adjustment factor of 1.45 was applied to the September 2020 traffic volumes to represent pre-pandemic traffic conditions, based on the historical data. In addition, the April 2019 turning movement count volumes recorded for the north leg of the Plains Road East intersection with Gallagher Road were used to reflect typical school volumes. The adjustment factor was reviewed and confirmed by City Transportation Planning Staff during pre-study consultation.

Figure 2.5 illustrates the existing base year AM and PM peak hour traffic volumes at the study area intersections. **Appendix B** contains the existing count data and signal timings.



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Base Year Traffic Volumes

2.5 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the efficiency of traffic flow at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles desiring to make a movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to the opposing traffic flows. The highest possible rating is LOS A, under which the average total delay is equal or less than 10 seconds per vehicle. When the average delay exceeds 80 seconds at signalized intersections (50 seconds at unsignalized), the movement is considered to have a LOS F and remedial measures are usually implemented if they are feasible.

The operations of the intersections in the study area were evaluated using the existing lane configuration, traffic control, existing base year traffic volumes and signal timings. The intersection analysis considered three separate measures of performance:

- The LOS for each turning movement;
- The volume to capacity ratio (v/c) for each movement; and
- The 95th percentile queue lengths estimated using Synchro.

Synchro 11 was used to determine traffic operations at the study area intersections. In accordance with the Halton Region's TIS Guidelines[4], the following criteria were used in the determination of critical movements:

- Volume/capacity (V/C) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.85 or above.
- V/C ratios for exclusive movements that will exceed 0.95.
- 95th percentile queue lengths for individual movements exceeds available lane storage; and
- Level of Service (LOS), based on average delay per vehicle, on individual movements exceeds LOS D.

Table 2.2 summarizes the base year level of service conditions, and the following critical movements are noted:

Plains Road East at Shadeland Avenue/Gallagher Road

[4] Halton Region, *Transportation Impact Study Guidelines,* (Oakville: Halton Region,2015).

- Southbound left-turn queue is estimated to exceed the current available storage length by approximately 16 m (31 m total) during the AM peak hour;
- Northbound left-turn queue is estimated to exceed the current available storage length by approximately 1 m (16 m total) during the PM peak hour;
- Southbound left-turn queue is estimated to exceed the current available storage length by approximately 3 m (18 m total) during the PM peak hour.

Plains Road East at Filmandale Road/Private Driveway

- Southbound approach (private driveway) is estimated to operate at LOS E (v/c = 0.09) during the PM peak hour.

Appendix C contains the supporting detailed Synchro 11 output.

TABLE 2.2: EXISTING OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	C	C	>	**C**	D	C	>	**D**	**A**
			Delay	4	5	>	**5**	4	5	>	**5**	35	34	>	**34**	39	34	>	**37**	**9**
			V/C	0.07	0.39	>		0.06	0.32	>		0.11	0.09	>		0.43	0.09	>		**0.40**
			Q	4	52	>		4	38	>		9	12	>		31	13	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	41	-	>		36	-	>		6	-	>		-16	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	A	A	>	**A**	B	A	>	**A**	<	B	>	**B**	<	B	>	**B**	
			Delay	9	0	>	**0**	11	0	>	**0**	<	14	>	**14**	<	10	>	**10**	
			V/C	0.00	0.37	>		0.04	0.31	>		<	0.07	>		<	0.00	>		
			Q	0	0	>		1	0	>		<	2	>		<	0	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		29	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	1	2	>	**2**	2	2	>	**2**	<	41	>	**41**	<	42	>	**42**	**4**
			V/C	0.04	0.34	>		0.03	0.28	>		<	0.02	>		<	0.11	>		**0.31**
			Q	1	17	>		1	21	>		<	6	>		<	12	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	29	-	>		14	-	>		<	-	>		<	-	>		
PM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	D	D	>	**D**	D	D	>	**D**	**A**
			Delay	3	4	>	**4**	4	4	>	**4**	42	39	>	**40**	42	39	>	**40**	**6**
			V/C	0.05	0.44	>		0.21	0.55	>		0.27	0.06	>		0.29	0.09	>		**0.52**
			Q	2	52	>		5	45	>		16	11	>		18	12	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	43	-	>		35	-	>		-1	-	>		-3	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	B	A	>	**A**	B	A	>	**A**	<	B	>	**B**	<	E	>	**E**	
			Delay	14	0	>	**0**	12	0	>	**0**	<	15	>	**15**	<	42	>	**42**	
			V/C	0.01	0.49	>		0.06	0.63	>		<	0.12	>		<	0.09	>		
			Q	0	0	>		1	0	>		<	3	>		<	2	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		29	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	3	3	>	**3**	3	4	>	**4**	<	41	>	**41**	<	42	>	**42**	**5**
			V/C	0.16	0.44	>		0.11	0.58	>		<	0.07	>		<	0.22	>		**0.54**
			Q	3	33	>		4	72	>		<	10	>		<	17	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	27	-	>		11	-	>		<	-	>		<	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Second
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

3 Development Concept

3.1 Site Description

The subject site is located at 284-292 Plains Road East in the City of Burlington. The site is adjacent to the City of Burlington's Aldershot Major Transit Station Area (MTSA). The city defines this area as an intensification area and is intended to foster a more pedestrian and transit friendly urban environment through a mix of dense residential, employment, and retail land uses. **Figure 3.1** illustrates the layout of the subject site.

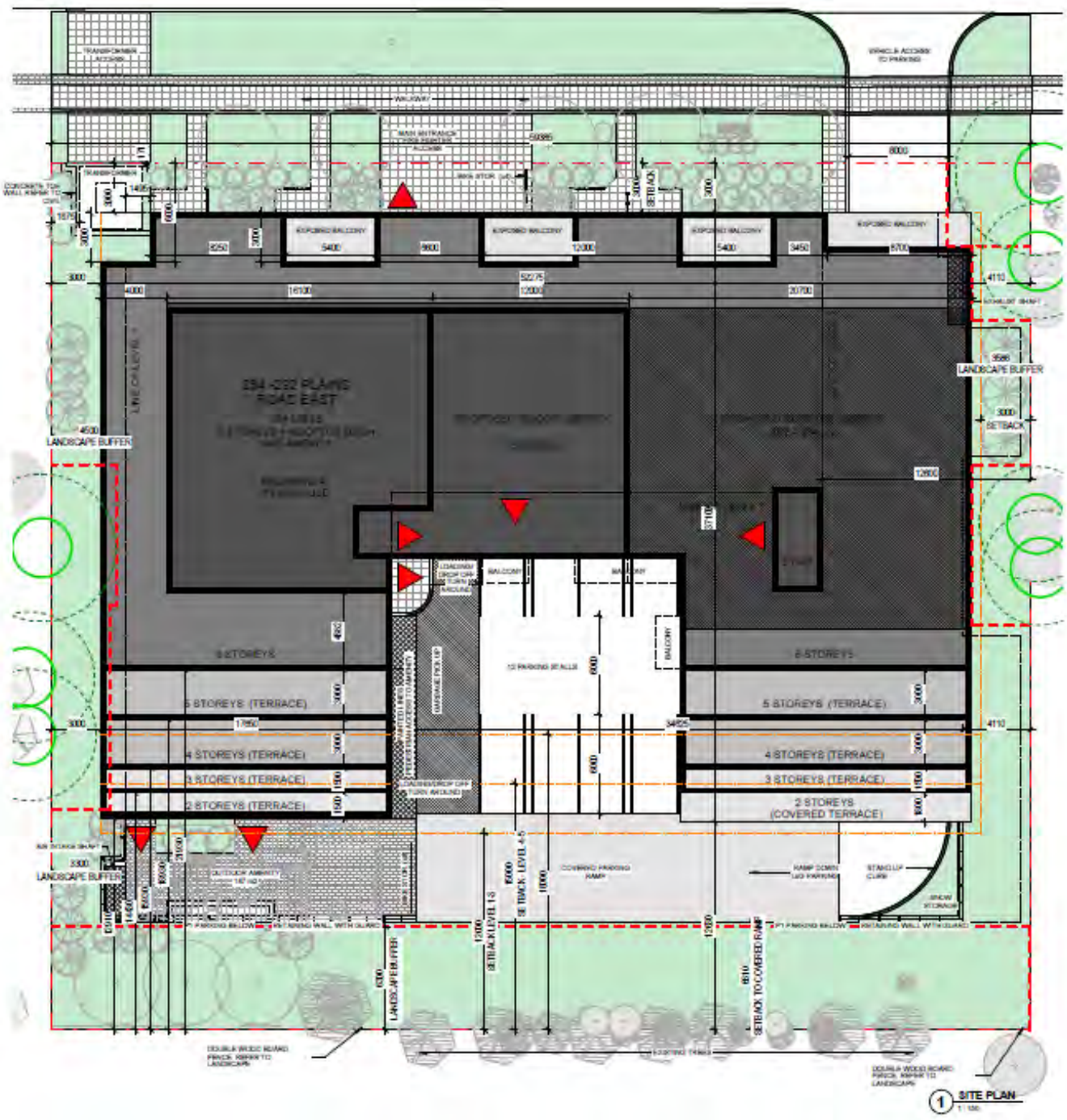
The proposed 7-storey mid-rise building contains 107 units and 116 parking spaces (1.08 spaces per unit). Occupant parking is identified on the site plan as 107 spaces (1.00 spaces per unit) and visitor parking is identified on the site plan as 9 spaces (0.08 spaces per unit).

The proposed site plan consolidates the three existing private driveways to Plains Road East into one driveway. The proposed driveway is located approximately 75 m west of Filmandale Road.

A sidewalk connection is proposed between the building's main entrance and the existing sidewalk across the site's Plains Road East frontage. The ground floor units fronting Plains Road East have direct at grade connections to the existing sidewalk along Plains Road East.

The site is expected to be built-out and occupied by Year 2025.

Plains Road East



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Site Concept Plan

284-292 Plains Road East TIS PS TDM
200104

Figure 3.1

3.2 Transportation Demand Management

The site plan includes Transportation Demand Management (TDM) measures to help improve transportation efficiency (reduced congestion), encourage use of alternative modes, reduce reliance on single occupant vehicles, and encourage a change in behaviour. The proposed TDM measures include:

- **Walking** – Pedestrian oriented design with walking paths to connect the development with adjacent sidewalks. The pedestrian realm to the rear of the building will include amenities such as benches, seating areas and pedestrian scale lighting;
- **Transit** – Proximity to existing transit service (City and Regional GO Transit) and discounted transit passes for first time purchasers during the first year of occupancy will be considered as a marketing item;
- **Cycling** – On-site bicycle parking
  - Bicycle parking – 91 long-term bicycle parking spaces and 12 short-term bicycle parking spaces are proposed;
  - The site connects to the City's existing cycling network; and
  - The City of Burlington's Cycling Plan identifies a Protected Bikeway along Plains Road East through the study area.
- **Parking** – Reduced on-site parking supply to complement the future intensification plans for the Mobility Hub. The Aldershot MTSA envisions a dense walkable, bikeable, and transit-oriented urban environment with a mix of land uses.

  The applicant intends to unbundle parking costs from residential unit costs. This allows residents to purchase a unit without a parking space.
- **Wayfinding and Travel Planning** – Travel planning resources for residents (individualized marketing, active transportation transit information, transit and cycling maps, community resources) will be provided. Wayfinding signage to major destinations such as schools, public amenities, GO transit and commercial areas will be provide in the landscaping plan or lobby area; and
- **Education/ Promotion, Incentives** – Contribute to building a strong TDM brand in marketing material.

3.3 Site Traffic Forecast

The Institute of Transportation Engineers (ITE) Trip Generation manual[5] equation rates for Land Use Code (LUC) Multifamily Housing (Mid-Rise) (221) were used to estimate the site-generated trips.

Table 3.1 summarizes the forecast site-generated trips indicating 35 vehicle trips during the AM peak hour and approximately 42 vehicle trips during the PM peak hour. To remain conservative, no reductions have been made to account for modal choice.

TABLE 3.1: FORECAST SITE-GENERATED TRIPS

Land Use	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Sum	In	Out	Sum
Multifamily Housing (Mid-Rise) - Not Close to Rail Transit (221)[1]	104	8	27	**35**	26	16	**42**
Total Generation		**8**	**27**	**35**	**26**	**16**	**42**

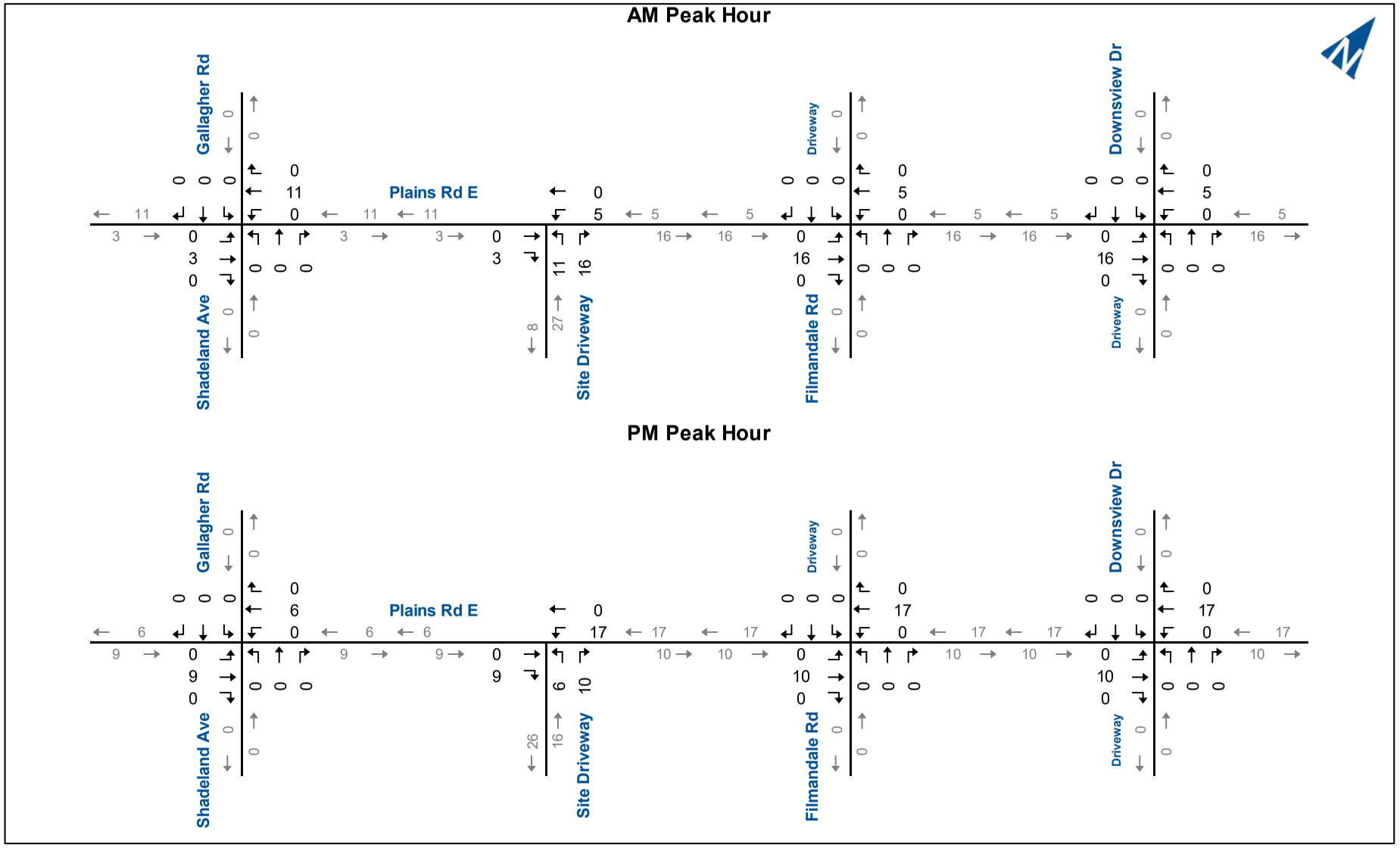
1 Fitted Curve Equation: AM Peak Hour, T = 0.44(X) - 11.61
Fitted Curve Equation: PM Peak Hour, T = 0.39(X) + 0.34

Table 3.2 summarizes the estimated trip distribution. The distribution for site generated traffic is based on existing travel patterns as documented under existing conditions. Travel patterns are expected to follow the existing commuter flows observed for the surrounding residential land uses. **Figure 3.2** illustrates the site-generated traffic estimates.

TABLE 3.2: ESTIMATED PEAK HOUR TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
West via Plains Rd E	40%	40%	35%	40%
East via Plains Rd E	60%	60%	65%	60%
Total	**100%**	**100%**	**100%**	**100%**

[5] Institute of Transportation Engineers, *Trip Generation Manual,* 11th ed., (Washington DC: ITE, 2021).



Site Generated Traffic

Figure 3.2

4 Future Conditions

The assessment of the future traffic conditions contained in this section includes the future traffic forecasts and intersection operational analysis.

4.1 Traffic Forecast

A five-year horizon (Year 2030) following the anticipated build-out of the site (Year 2025) has been assessed. The likely future traffic volumes near the subject site are estimated to consist of:

- Increased non-site traffic (generalized background traffic growth);
- Traffic generated by the build-out of nearby in-stream developments; and
- Traffic generated by the subject site (**Section 3.3**).

4.1.1 Generalized Background Traffic

The non-site traffic increase is the generalized traffic growth near the subject site, which is anticipated to follow the average increase in population in the area. During pre-study consultations, City staff identified an annual growth rate of 1% per annum.

4.1.2 Other Developments

During pre-study consultations, City staff requested the inclusion of traffic generated by the following nearby in-stream developments:

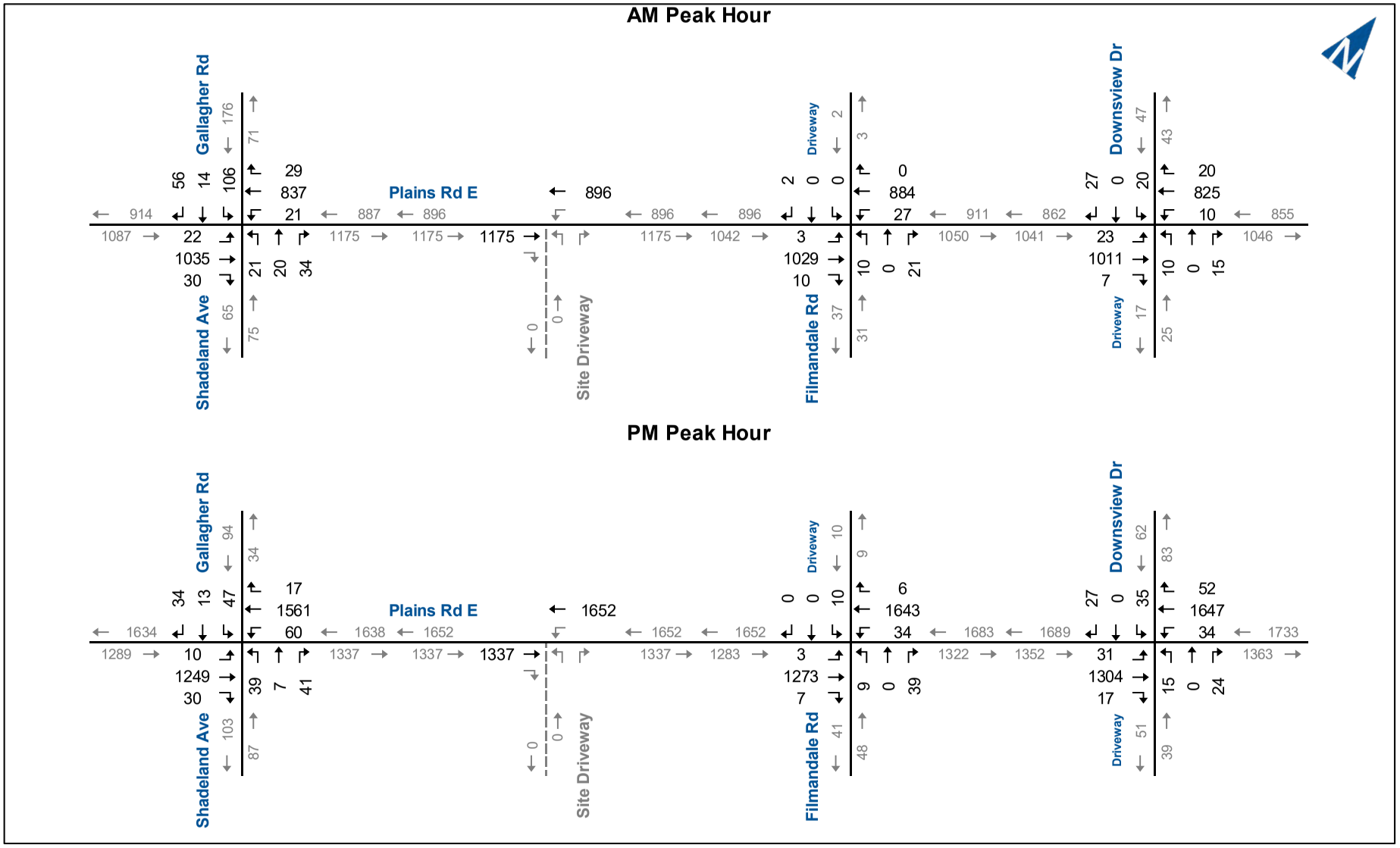
- 53-71 Plains Road East, a mixed-use development estimated to contain approximately 450 residential units with ground floor commercial space[6]; and
- 484 Plains Road East, a mixed-use development estimated to contain approximately 397 residential units with ground floor commercial space[7].

Appendix D contains the detailed traffic forecast for the adjacent development applications.

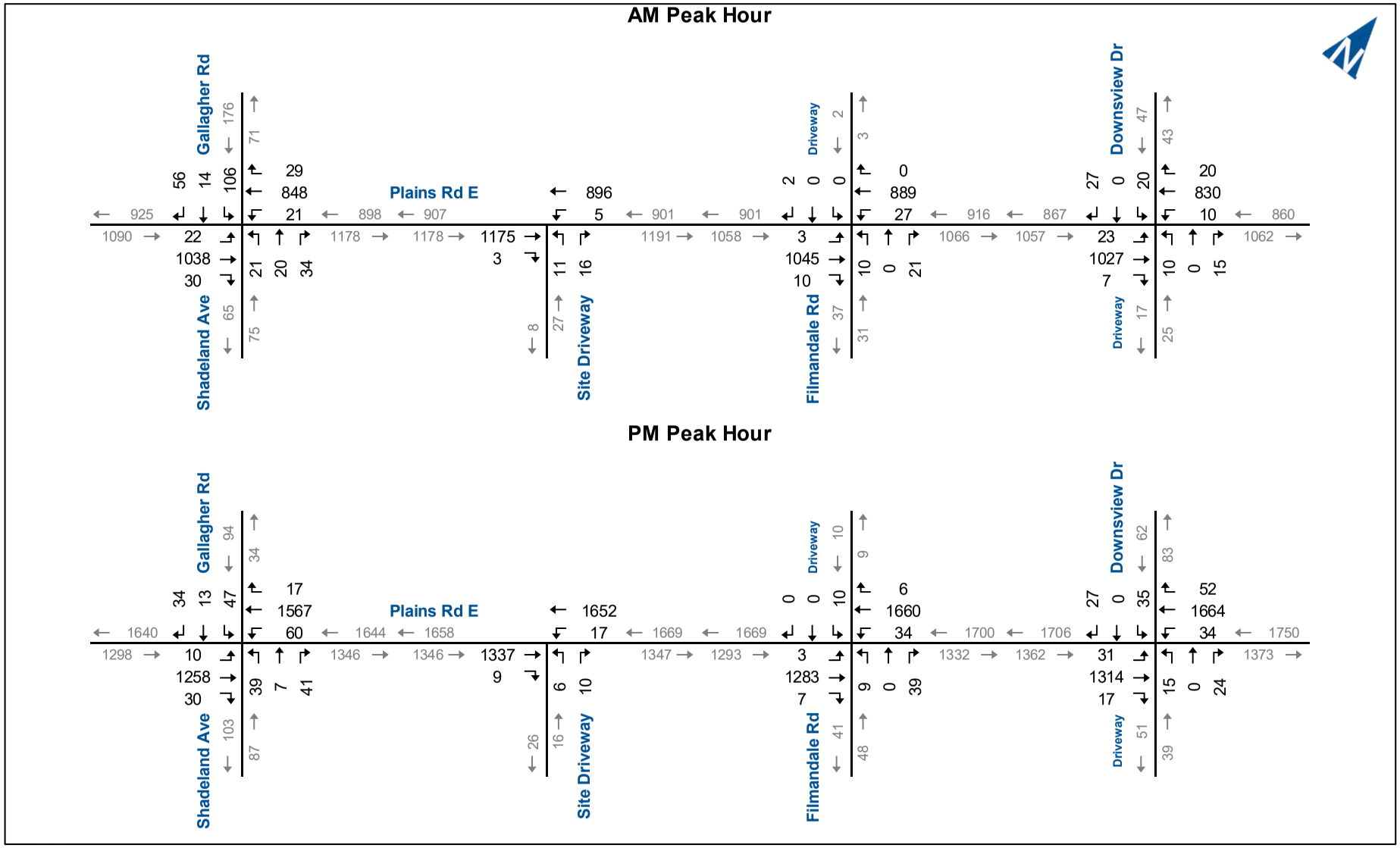
[6] Paradigm Transportation Solutions Limited, *53 & 71 Plains Road East Transportation Impact Study, Parking Study & TDM Options Report,* (Cambridge: PTSL, 2017).
[7] BA Consulting Group Ltd, *484 Plains Road East Mixed-Use Development Transportation Impact Study,* (Toronto: BA Group, 2017).

Figure 4.1 illustrates the forecast Background Traffic volumes, which is the combination of the generalized background growth and the traffic volumes generated by the adjacent developments.

Figure 4.2 illustrates the forecast Total Traffic volumes which is the combination of the forecast background traffic volumes and the site-generated traffic volumes.



Forecast Background Traffic



Forecast Total Traffic

4.2 Background Traffic Operations

The study area intersection operations analyses for the background traffic forecast followed the same methodology used for existing conditions. Signal timings have been optimized. **Table 4.1** summarizes the level of service conditions for the forecast background traffic volumes and the following critical movements are noted:

Plains Road East at Shadeland Avenue/Gallagher Road

- Southbound left-turn queue is estimated to exceed the current available storage length by approximately 19 m (34 m total) during the AM peak hour;
- Northbound left-turn queue is estimated to exceed the current available storage length by approximately 5 m (20 m total) during the PM peak hour;
- Southbound left-turn queue is estimated to exceed the current available storage length by approximately 8 m (23 m total) during the PM peak hour.

Plains Road East at Filmandale Road/Private Driveway

- Southbound approach (private driveway) is estimated to operate at LOS F (v/c < 0.16) during the PM peak hour.

Appendix E contains the supporting detailed Synchro 11 output

The above noted capacity deficiencies are forecast to occur under the future background condition. These deficiencies are not related, nor are a result of the development of the subject site.

To accommodate the forecast southbound left-turn queue at the Plains Road East and Shadeland Avenue/Gallagher Road intersection, the city can consider extending the left-turn lane to provide 35 m of storage.

To accommodate the forecast northbound left-turn queue at the Plains Road East and Shadeland Avenue/Gallagher Road intersection, the city can consider extending the left-turn lane to provide 20 m of storage. The queue is forecast to exceed the storage length by 5 m and can likely be accommodated by the taper lane length.

TABLE 4.1: BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	C	C	>	**C**	D	C	>	**D**	**A**
			Delay	5	6	>	**6**	4	4	>	**4**	34	34	>	**34**	39	34	>	**37**	**9**
			V/C	0.10	0.46	>		0.09	0.38	>		0.12	0.10	>		0.46	0.10	>		**0.46**
			Q	5	65	>		3	25	>		10	13	>		34	13	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	40	-	>		37	-	>		5	-	>		-19	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	A	A	>	**A**	B	A	>	**A**	<	C	>	**C**	<	B	>	**B**	
			Delay	10	0	>	**0**	11	0	>	**0**	<	15	>	**15**	<	11	>	**11**	
			V/C	0.00	0.43	>		0.05	0.37	>		<	0.09	>		<	0.00	>		
			Q	0	0	>		1	0	>		<	2	>		<	0	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		29	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	2	2	>	**2**	2	2	>	**2**	<	41	>	**41**	<	42	>	**42**	**4**
			V/C	0.06	0.39	>		0.03	0.33	>		<	0.02	>		<	0.15	>		**0.36**
			Q	2	30	>		2	27	>		<	6	>		<	14	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	28	-	>		13	-	>		<	-	>		<	-	>		
PM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	D	D	>	**D**	D	D	>	**D**	**A**
			Delay	3	4	>	**4**	3	2	>	**2**	52	48	>	**50**	52	49	>	**50**	**6**
			V/C	0.07	0.50	>		0.28	0.62	>		0.33	0.07	>		0.35	0.14	>		**0.58**
			Q	2	69	>		1	12	>		20	13	>		23	16	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	43	-	>		39	-	>		-5	-	>		-8	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	C	A	>	**A**	B	A	>	**A**	<	C	>	**C**	<	F	>	**F**	
			Delay	16	0	>	**0**	13	0	>	**0**	<	17	>	**17**	<	66	>	**66**	
			V/C	0.01	0.57	>		0.08	0.73	>		<	0.15	>		<	0.16	>		
			Q	0	0	>		2	0	>		<	4	>		<	4	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		28	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	5	3	>	**3**	3	4	>	**4**	<	51	>	**51**	<	52	>	**52**	**5**
			V/C	0.24	0.50	>		0.15	0.65	>		<	0.15	>		<	0.31	>		**0.62**
			Q	4	57	>		5	103	>		<	14	>		<	22	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	26	-	>		10	-	>		<	-	>		<	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Second
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

4.3 Total Traffic Operations

The study area intersection operations analyses for the total traffic forecast followed the same methodology used for background conditions. Signal timings have been optimized. **Table 4.2** summarizes the level of service conditions for the forecast total traffic volumes.

Total traffic operations are forecast to operate like background conditions and no additional critical movements are noted.

The capacity deficiencies forecast to occur under the future background conditions are expected to continue to occur with the addition of site generated traffic. Minor increases in delay and queueing is expected because of the additional site-generated traffic.

The queuing issue forecast to occur for the northbound and southbound left-turn movements at the Plains Road East and Shadeland Avenue/Gallagher Road intersection is expected to continue. The forecast queue lengths remain unchanged compared to the background traffic operation. Although, the southbound left-turn queue at the intersection of Plains Road East and Gallagher Road/Shadeland Avenue is estimated to exceed the current available storage length by approximately 21 m (36 m total) during the AM peak hour. Site generated traffic is not expected to contribute volumes to these movements.

To accommodate the forecast southbound left-turn queue at the Plains Road East and Shadeland Avenue/Gallagher Road intersection, the city can consider extending the left-turn lane to provide 40 m of storage.

The site driveway approach to Plains Road East is forecast to operate with delays in LOS B to C range with a v/c ratio of less than 0.10. Queue lengths on the site driveway approach are forecast to be less than 5 m.

The westbound left-turn movement into the subject site is forecast to operate with delays in the LOS A range with a v/c ratio of less than 0.05. The westbound left-turn queue length is forecast to be less than 5 m and can be accommodated by the existing centre two-way left-turn lane.

Appendix F contains the supporting detailed Synchro 11 output

TABLE 4.2: TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	D	D	>	**D**	D	D	>	**D**	**A**
			Delay	5	6	>	**6**	3	4	>	**4**	36	36	>	**36**	41	36	>	**39**	**9**
			V/C	0.10	0.45	>		0.08	0.38	>		0.13	0.10	>		0.47	0.10	>		**0.46**
			Q	5	66	>		2	22	>		10	14	>		36	14	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	40	-	>		38	-	>		5	-	>		-21	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	A	A	>	**A**	B	A	>	**A**	<	C	>	**C**	<	B	>	**B**	
			Delay	10	0	>	**0**	11	0	>	**0**	<	16	>	**16**	<	11	>	**11**	
			V/C	0.00	0.44	>		0.05	0.37	>		<	0.09	>		<	0.00	>		
			Q	0	0	>		1	0	>		<	2	>		<	0	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		29	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	2	2	>	**2**	2	2	>	**2**	<	43	>	**43**	<	44	>	**44**	**4**
			V/C	0.06	0.39	>		0.03	0.33	>		<	0.02	>		<	0.17	>		**0.37**
			Q	2	30	>		1	27	>		<	7	>		<	14	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	28	-	>		14	-	>		<	-	>		<	-	>		
	Site Driveway & Plains Rd E	TWSC	LOS		A	>	**A**	<	A		**A**	C		>	**C**					
			Delay		0	>	**0**	<	0		**0**	15		>	**15**					
			V/C		0.50	>		<	0.38			0.08		>						
			Q		0	>		<	0			2		>						
PM Peak Hour	Gallagher Rd/Shadeland Ave & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	D	D	>	**D**	D	D	>	**D**	**A**
			Delay	3	4	>	**4**	3	2	>	**2**	52	48	>	**50**	52	49	>	**50**	**6**
			V/C	0.07	0.50	>		0.28	0.62	>		0.33	0.07	>		0.35	0.14	>		**0.59**
			Q	2	70	>		1	12	>		20	13	>		23	16	>		
			Stor.	45	-	>		40	-	>		15	-	>		15	-	>		
			Avail.	43	-	>		39	-	>		-5	-	>		-8	-	>		
	Filmandale Rd & Plains Rd E	TWSC	LOS	C	A	>	**A**	B	A	>	**A**	<	C	>	**C**	<	F	>	**F**	
			Delay	16	0	>	**0**	13	0	>	**0**	<	17	>	**17**	<	68	>	**68**	
			V/C	0.01	0.57	>		0.08	0.74	>		<	0.16	>		<	0.16	>		
			Q	0	0	>		2	0	>		<	4	>		<	4	>		
			Stor.	15	-	>		30	-	>		<	-	>		<	-	>		
			Avail.	15	-	>		28	-	>		<	-	>		<	-	>		
	Downsview Dr & Plains Rd E	TCS	LOS	A	A	>	**A**	A	A	>	**A**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	6	3	>	**3**	3	5	>	**5**	<	51	>	**51**	<	52	>	**52**	**5**
			V/C	0.24	0.50	>		0.16	0.66	>		<	0.15	>		<	0.31	>		**0.62**
			Q	4	58	>		5	106	>		<	14	>		<	22	>		
			Stor.	30	-	>		15	-	>		<	-	>		<	-	>		
			Avail.	26	-	>		10	-	>		<	-	>		<	-	>		
	Site Driveway & Plains Rd E	TWSC	LOS		A	>	**A**	<	A		**A**	C		>	**C**					
			Delay		0	>	**0**	<	1		**0**	17		>	**17**					
			V/C		0.57	>		<	0.70			0.06		>						
			Q		0	>		<	1			1		>						

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
V/C - Volume to Capacity Ratio
Q - 95th Percentile Queue Length (m)
Stor. - Existing Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
< / > - Shared with through movement

5 Parking Justification

5.1 Proposed Parking Supply

The site's parking demand is proposed to be accommodated on site by 116 spaces (1.08 spaces per unit). Twelve spaces are located at grade with the remaining spaces (104 spaces) contained in an underground parking structure

The site statistics indicate a proposed total of 91 long-term bicycle parking spaces (0.85 spaces per unit) and 12 short-term bicycle parking spaces (0.11 spaces per unit).

Occupant parking is proposed at a rate of 1.00 space per unit and visitor parking is proposed at a rate of 0.08 spaces per unit.

These rates were developed and recommended by City staff based on first submission comments. The parking rate is supported by supplemental data collected by City Staff for residential land uses in intensification areas.

5.2 Zoning By-Law Requirements

The City of Burlington's Zoning By-law 2020[8] prescribes parking ratios for apartment buildings for Occupants (O) and Visitors (V). The zoning by-law mandates 1.25 spaces per unit inclusive of visitor parking for apartment buildings within a Secondary Growth Area.

Table 5.1 summarizes the site's Zoning By-law 2020 parking requirements for the current site concept plan.

Overall, the site's parking supply is considered deficient by 18 spaces when compared to Zoning By-law 2020.

TABLE 5.1: ZONING BY-LAW PARKING REQUIREMENT

Apartment Building	Units	Ratio	Calculation
Occupant and Visitor	107	1.25	134
Total			**134**

[8] City of Burlington Zoning By-Law 2020, Part 1 - General Conditions and Provisions: 2.0 General Provisions.

5.3 Industry Parking Guidelines

There are numerous industry associations that are dedicated to the survey and review of parking requirements related to various land uses. These associations, such as the Institute of Transportation Engineers (ITE), collect, review, and publish information related to parking demand, supply, and appropriate design standards.

An accepted industry standard for the determination of potential parking demand is ITE's Parking Generation Manual[9]. ITE provides data on surveys across the USA and Canada of peak parking demand for different land uses.

ITE Parking Generation is regarded as a reliable source for measured parking demands when local data cannot be readily collected at similar land uses.

Land use code 221 (Multi-family Housing (Mid-Rise)) in the Parking Generation Manual is applicable to sites located General Urban/Suburban (no nearby rail transit). **Table 5.2** summarizes the estimated peak parking generation for the subject site.

ITE data does not aggregate the parking generation data by occupant or visitor. The data is an overall rate for both occupant and visitor parking demands.

The site's parking demand using the ITE methodology is estimated to be approximately 108 parking spaces. The site's parking demand is forecast to be less than the proposed supply of 116 parking spaces.

[9] Institute of Transportation Engineers, *Parking Generation,* 5th ed., (Washington, DC: ITE, 2019).

TABLE 5.2: ITE PARKING GENERATION

Land Use	Multifamily Housing (Mid-Rise) (221)
Variable	**Bedrooms (157 bedrooms)**
Period	**Weekday (Monday - Friday)**
Setting	**General Urban/Suburban (no nearby rail transit)**
Number of Studies:	35
Avg. Num. of Dwelling Units:	294
Average Rate:	0.75
Range of Rates:	0.41 – 1.00
33rd / 85th Percentile:	0.65 / 0.87
95% Confidence Interval:	0.70 – 0.80
Standard Deviation:	0.15
Coefficient of Variation:	20%
Fitted Curve Equation:	P = 0.82(X)-20.37
R2:	0.94
Calculated Parking Demand:	**Fitted Curve: 108 spaces**

6 Conclusions and Recommendations

6.1 Conclusions

The main findings and conclusions of this study are as follows:

- **Study Area**: The intersections that form the study area include:
  - Plains Road East and Shadeland Avenue/Gallagher Road (signalized);
  - Plains Road East and Filmandale Road (unsignalized);
  - Plains Road East and Downsview Drive (signalized); and
  - Plains Road East and the proposed site driveway.
- **Existing Traffic Conditions**: The intersections within the study area are generally operating with acceptable levels of service during the AM and PM peak hours. The following critical movements are noted:
  - Plains Road East at Shadeland Avenue/Gallagher Road: The northbound and southbound queue lengths are estimated to exceed the current available storage length; and
  - Plains Road East at Filmandale Road/Private Driveway: Localized congestion is occurring on the southbound approach (private driveway).
- **Forecast Traffic**: The forecast traffic volumes near the subject site have been assessed for a five-year horizon (Year 2030) from the anticipated build-out date (Year 2025).
- **Background Traffic Conditions**: The noted queue lengths and localized congestion identified under existing conditions is anticipated to continue to occur.
- **Site Generated Traffic**: The subject site is forecast to generate approximately 35 vehicle trips during the AM peak hour and approximately 42 vehicle trips during the PM peak hour.
- **Transportation Demand Management**: The site concept plan includes TDM measures intended to assist in mitigating the site's transportation and parking impacts. Measures are aimed at walk, transit, cycling, parking, and education/promotion.
- **Parking Demand**: The site's parking demand is forecast to be less than the proposed supply.

  Occupant parking is proposed at a rate of 1.00 space per unit and visitor parking is proposed at a rate of 0.08 spaces per unit.

These rates were developed and recommended by City staff based on first submission comments. The parking rate is supported by supplemental data collected by City Staff for residential land uses in intensification areas and published data by ITE.

- **Total Traffic Conditions**: The intersections within the study area are forecast to operate with similar levels of service as background traffic conditions. No additional critical movements are noted because of the addition of the site-generated traffic.

6.2 Recommendations

Based on the findings of this study, it is recommended that the City of Burlington consider extending the northbound and southbound storage lengths at the Plains Road East and Shadeland Avenue/Gallagher Road intersection to accommodate 20 m and 40 m of storage, respectively.

Appendix A

Pre-Study Consultation

Appendix B

Existing Data

Appendix C

Existing Traffic Operations



Appendix D

Detailed Background Traffic Forecast

Appendix E

Background Traffic Operations



Appendix F

Total Traffic Operations

